

# PATENT ABSTRACTS OF JAPAN

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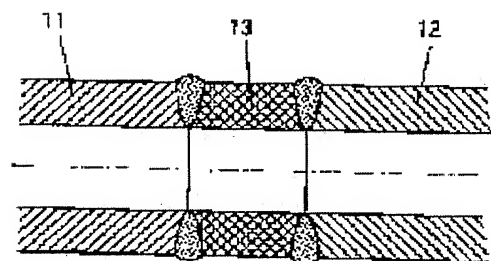
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(54) WELDING METHOD FOR STEEL PRODUCTS WHOSE COMPOSITIONS ARE  
DIFFERENT FROM EACH OTHER

(57)Abstract:

PROBLEM TO BE SOLVED: To weld a ferritic steel and an austenitic steel with each other by interposing an intermediate material whose compositions of both end parts are similar to a composition of respective steel products between two kinds of steel products whose compositions are different from each other, and welding the intermediate material and two kinds of steel materials.

SOLUTION: An intermediate material 13 is manufactured beforehand. The intermediate material 13 is manufactured by powder metallurgy by changing a component step by step so that a composition of a parts for welding two kinds of steel



products 11, 12 (a ferritic steel pipe and an austenitic steel pipe) are similar to a composition of respective steel products. A manufactured intermediate material 13 is interposed between the ferritic steel pipe 11 and the austenitic steel pipe 12, and it is welded with two kinds of steel products 11, 12. In this case, in both end parts of the intermediate material 13, the ferritic end part and welded with the ferritic steel pipe 11, and an austenitic end part is welded with the austenitic steel pipe 12.

[Claim(s)]

[Claim 1]A welding process of steel materials in which presentations characterized by what a presentation of both ends makes intermediate assemblies (13) approximated to a presentation of each steel materials intervene, and welds these intermediate assemblies and two sorts of steel materials for, respectively among two sorts of steel materials (11, 12) in which presentations differ differ.

[Claim 2]A welding process of steel materials in which the presentations according to claim 1 characterized by what an ingredient is changed gradually and manufactured for with powder-metallurgy processing so that a presentation of both ends may approximate said intermediate assemblies (13) to a presentation of each steel materials differ.

## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the welding process of the steel materials in which presentations differ.

[0002]

[Description of the Prior Art]For example, when welding the steel materials of each other in which presentations differ by arc welding, TIG arc welding, etc., welding both directly is widely performed by usually using the material near low-grade side steel materials for a welding material.

[0003]However, when steel materials which a presentation is large and are different, for example, the ferrite series steel materials whose Cr content is very low, and austenitic steel materials with a high Cr content are welded directly. Since both coefficients of thermal expansion differ greatly, heat stress remains to a weld zone, or heat stress occurs according to thermal expansion difference during the use under hot environments, a weld zone is cracked by repeated use, and the problem which results in a fracture etc. arises.

[0004]

[Problem(s) to be Solved by the Invention]In order to solve this problem, by the "joining method of the pipe of a different strand" of JP,54-31210,B, the method of welding via the shell 2 contained so that a specific component may become a middle presentation is indicated so that it may illustrate to drawing 3. In the 1st example of drawing 3 (A), this method carries out butt welding of the shell terminal areas 7 and 8 to the shells 1 and 3 from which a presentation differs beforehand, and ranks second

to them, The shell 2 is pinched in the meantime, friction welding of the planes of composition 4 and 4 is carried out simultaneously, in the 2nd example of drawing 3 (B), the shell 2 is pinched directly, without using the shell terminal areas 7 and 8, and friction welding of the planes of composition 4 and 4 is carried out simultaneously.

[0005]However, in the joining method of JP,54-31210,B mentioned above, friction welding needed to perform the capping pass. This friction welding is the method of welding with the frictional heat which is made to carry out the high velocity revolution of the member of one side or both, and is generated in the meantime. Therefore, in order to have applied this welding process, the large-sized and special equipment for \*\* friction welding was needed, \*\* at least one side was limited to the cylindrical shape member (for example, tubing material), and there was a problem of \*\* which cannot be welded directly by arc welding, TIG arc welding, etc. in \*\* construction site etc.

[0006]This invention is originated in order to fill this request. That is, the purpose of this invention is to provide the welding process which can weld directly steel materials which a presentation is large and are different, for example, ferrite series steel materials and austenitic steel materials, in a construction site etc. without using special appliances. Another purpose of this invention is to provide a welding process applicable also to steel materials other than a tubing material.

[0007]

[Means for Solving the Problem]According to this invention, a welding process of steel materials in which presentations characterized by what a presentation of both ends makes intermediate assemblies (13) approximated to a presentation of each steel materials intervene, and welds these intermediate assemblies and two sorts of steel materials for, respectively among two sorts of steel materials (11, 12) in which presentations differ is provided. According to the desirable embodiment of this invention, an ingredient is changed gradually and manufactured with powder-metallurgy processing so that a presentation of both ends may approximate said intermediate assemblies (13) to a presentation of each steel materials.

[0008]According to the welding process of the above and this invention, ferrite series steel and austenitic steel are welded, for example via intermediate assemblies (13) to which a ferrite series ingredient and an austenitic ingredient were changed gradually. These intermediate assemblies 13 can be easily manufactured with powder-metallurgy processing, such as HIP. Since a presentation of both ends (weld zone) of intermediate assemblies (13) resembles a presentation of each steel materials (for example, ferrite series steel and austenitic steel) according to this

welding process, It may be sufficient as a welding process of each steel materials and intermediate assemblies with the former that it is the same (for example, arc welding, TIG arc welding, etc.), for example, it can be directly welded in a construction site etc. using a ferrite series and austenitic welding materials. moreover -- since each weld zone has same coefficient of thermal expansion or it approximates it, heat stress hardly occurs in a weld zone -- and the bottom of hot environments -- since heat stress hardly occurs according to thermal expansion difference even if it uses it, there is no fear of damage. Since an ingredient of intermediate assemblies (13) is changing gradually, heat stress generated inside intermediate assemblies also becomes very low. Since intermediate assemblies are manufactured with powder-metallurgy processing, such as HIP, and a capping pass is directly welded, for example by arc welding, TIG arc welding, etc., it is not limited to a cylindrical shape member (for example, tubing material), but can apply also to steel materials, such as a plate, as it is.

[0009]

[Embodiment of the Invention] Hereafter, the desirable embodiment of this invention is described with reference to drawings. Drawing 1 is a mimetic diagram of the welding process by this invention, and drawing 2 is a mimetic diagram of intermediate assemblies. Hereafter, the case where a ferrite series steel pipe and an austenitic steel pipe are welded is explained as two sorts of steel materials 11 and 12 in which presentations differ. This invention is not limited to welding of this ferrite series and austenite, but can be widely applied to two sorts of steel materials in which presentations differ. In this embodiment, although welding of pipes is explained, this invention is not limited to welding of a pipe, for example, can be applied to junction of boards, and the other appearance.

[0010] In order to enforce the welding process of this invention, the intermediate assemblies 13 are manufactured beforehand. These intermediate assemblies 13 change an ingredient gradually, and are manufactured with powder-metallurgy processing so that the presentation of two sorts of steel materials 11 and 12 (a ferrite series steel pipe and an austenitic steel pipe) and the portion (only henceforth both ends) to weld may resemble the presentation of each steel materials.

[0011] For example, in joining the pipes of the diameter of the same. The intermediate assemblies 13 are made into the short pipe shape of a cylindrical shape, the end part is considered as the same presentation (a Cr content is dramatically low) as a ferrite series steel pipe, the other end is considered as the same presentation (a Cr content is high) as an austenitic steel pipe, and the omitted portion is made the middle presentation of a ferrite series and austenite. Change of this presentation is good for

an inclined slope to make it change continuously so that it may illustrate to drawing 2 preferably, but it may be changed to step form at least more than a three-stage. These intermediate assemblies 13 can be easily manufactured with powder-metallurgy processing, such as HIP.

[0012]Next, between the ferrite series steel pipe 11 and the austenitic steel pipe 12, the manufactured intermediate assemblies 13 (short pipe) are made to intervene, and the intermediate assemblies 13 and two sorts of steel materials 11 and 12 are welded, respectively. In this case, a ferrite series end is welded to the ferrite series steel pipe 11, and, of course, an austenitic end is welded for the both ends of the intermediate assemblies 13 to the austenitic steel pipe 12. Since this welding turns into welding of a steel pipe of the same kind, it may be sufficient as a welding process with the former that it is the same (for example, arc welding, TIG arc welding, etc.), for example, it can be directly welded in a construction site etc. using a ferrite series and austenitic welding materials.

[0013]Of course, it can change variously in the range which this invention is not limited to the embodiment mentioned above, and does not deviate from the gist of this invention.

[0014]

[Effect of the Invention]Since the presentation of the both ends (weld zone) of intermediate assemblies (13) resembles the presentation of each steel materials (for example, ferrite series steel and austenitic steel) according to the welding process of this invention as mentioned above, It may be sufficient as the welding process of each steel materials and intermediate assemblies with the former that it is the same (for example, arc welding, TIG arc welding, etc.), for example, it can be directly welded in a construction site etc. using a ferrite series and austenitic welding materials. moreover -- since each weld zone has the same coefficient of thermal expansion or it approximates it, heat stress hardly occurs in a weld zone -- and the bottom of hot environments -- since heat stress hardly occurs according to thermal expansion difference even if it uses it, there is no fear of damage. Since the ingredient of intermediate assemblies (13) is changing gradually, the heat stress generated inside intermediate assemblies also becomes very low. Since intermediate assemblies are manufactured with powder-metallurgy processing, such as HIP, and a capping pass is directly welded, for example by arc welding, TIG arc welding, etc., it is not limited to a cylindrical shape member (for example, tubing material), but can apply also to steel materials, such as a plate, as it is.

[0015]Therefore, the welding process of the steel materials in which the presentations

of this invention differ has the effect which can weld directly steel materials which a presentation is large and are different, for example, ferrite series steel materials and austenitic steel materials, in a construction site etc., and can apply them also to steel materials other than a tubing material without using special appliances and which was excellent in \*\*.

[Brief Description of the Drawings]

[Drawing 1] It is a mimetic diagram of the welding process by this invention.

[Drawing 2] It is a mimetic diagram of intermediate assemblies.

[Drawing 3] It is an explanatory view of the conventional dissimilar-metal-welding method.

[Description of Notations]

1, 2, and 3 Shell

4 Plane of composition (friction welding side)

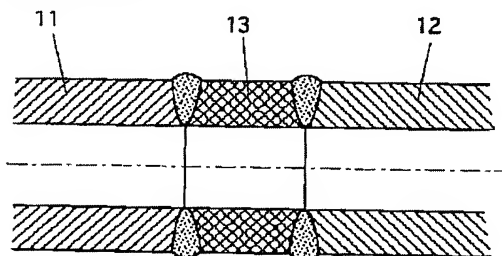
7 and 8 Shell terminal area

11 and 12 Steel materials

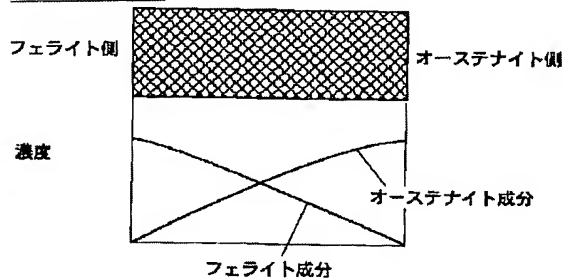
13 Intermediate assemblies

## DRAWINGS

[Drawing 1]

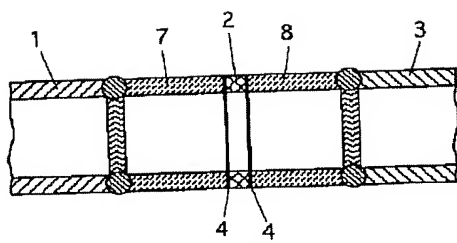


[Drawing 2]

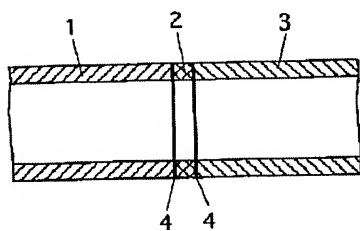


[Drawing 3]

(A)



(B)



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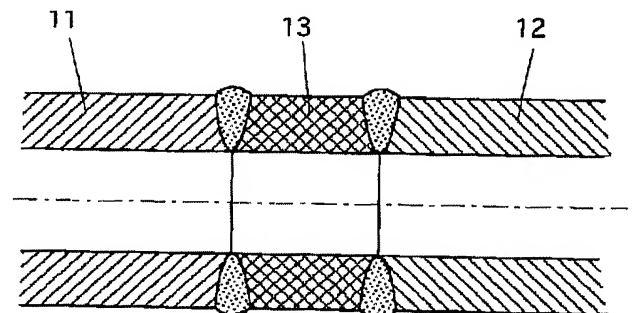
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(54)【発明の名称】 組成の異なる鋼材の溶接方法

(57)【要約】

【課題】 組成の大きく異なる鋼材、例えば、フェライト系鋼材とオーステナイト系鋼材を、特殊設備を用いることなく、工事現場等で直接溶接することができ、かつ管材以外の鋼材にも適用できる溶接方法を提供する。

【解決手段】 組成の異なる2種の鋼材11、12の間に、両端部の組成がそれぞれの鋼材の組成に近似した中間材13を介在させ、中間材と2種の鋼材とをそれぞれ溶接する。中間材は、両端部の組成がそれぞれの鋼材の組成に近似するように、成分を段階的に変化させて例えば粉末冶金法により製造する。





**【特許請求の範囲】**

**【請求項 1】** 組成の異なる 2 種の鋼材（1 1，1 2）の間に、両端部の組成がそれぞれの鋼材の組成に近似した中間材（1 3）を介在させ、該中間材と 2 種の鋼材とをそれぞれ溶接する、ことを特徴とする組成の異なる鋼材の溶接方法。

**【請求項 2】** 前記中間材（1 3）を、両端部の組成がそれぞれの鋼材の組成に近似するように、成分を段階的に変化させて粉末冶金法により製造する、ことを特徴とする請求項 1 に記載の組成の異なる鋼材の溶接方法。

**【発明の詳細な説明】****【0001】**

**【発明の属する技術分野】** 本発明は、組成の異なる鋼材の溶接方法に関する。

**【0002】**

**【従来の技術】** 例えばアーク溶接，TIG 溶接等により、組成の異なる鋼材を互いに溶接する場合には、通常、溶接材に低級側鋼材に近い材料を用いることにより、両者を直接溶接することが広く行われている。

**【0003】** しかし、組成の大きく異なる鋼材、例えば、Cr 含有量が非常に低いフェライト系鋼材と Cr 含有量が高いオーステナイト系鋼材を直接溶接した場合には、両者の熱膨張係数が大きく異なるため、溶接部に熱応力が残留し、或いは高温環境下での使用中に熱膨張差により熱応力が発生して、繰り返しの使用により溶接部に亀裂が生じ、破断等に至る問題が生じる。

**【0004】**

**【発明が解決しようとする課題】** この問題を解決するために、特公昭 5 4 - 3 1 2 1 0 号の「異なる素線の管の接合方法」では、図 3 に例示するように、特定成分が中間組成になるように含まれている管体 2 を介して溶接する方法が開示されている。この方法は、図 3（A）の第 1 実施例では、組成の異なる管体 1，3 に管体接続部 7，8 を予め突き合わせ溶接し、次いで、その間に管体 2 を挟持し、その接合面 4，4 を同時に摩擦溶接するものであり、図 3（B）の第 2 実施例では、管体接続部 7，8 を用いずに直接管体 2 を挟持し、その接合面 4，4 を同時に摩擦溶接するものである。

**【0005】** しかし、上述した特公昭 5 4 - 3 1 2 1 0 号の接合方法では、最終溶接を摩擦溶接で行う必要があった。この摩擦溶接は、一方又は両方の部材を高速回転させてその間で発生する摩擦熱で溶接する方法である。そのため、この溶接方法を適用するには、①摩擦溶接のための大型で特殊な設備を必要とし、②少なくとも一方が円筒形部材（例えば管材）に限定され、③工事現場等で例えばアーク溶接，TIG 溶接等により、直接溶接することができない、等の問題点があった。

**【0006】** 本発明は、かかる要望を満たすために創案されたものである。すなわち、本発明の目的は、組成の大きく異なる鋼材、例えば、フェライト系鋼材とオース

テナイト系鋼材を、特殊設備を用いることなく、工事現場等で直接溶接することができる溶接方法を提供することにある。また、本発明の別の目的は、管材以外の鋼材にも適用できる溶接方法を提供することにある。

**【0007】**

**【課題を解決するための手段】** 本発明によれば、組成の異なる 2 種の鋼材（1 1，1 2）の間に、両端部の組成がそれぞれの鋼材の組成に近似した中間材（1 3）を介在させ、該中間材と 2 種の鋼材とをそれぞれ溶接する、ことを特徴とする組成の異なる鋼材の溶接方法が提供される。本発明の好ましい実施形態によれば、前記中間材（1 3）を、両端部の組成がそれぞれの鋼材の組成に近似するように、成分を段階的に変化させて粉末冶金法により製造する。

**【0008】** 上記、本発明の溶接方法によれば、例えば、フェライト系成分とオーステナイト系成分を段階的に変化させた中間材（1 3）を介して、フェライト系鋼とオーステナイト系鋼を溶接する。この中間材 1 3 は、HIP 等の粉末冶金法により容易に製造することができる。この溶接方法によれば、中間材（1 3）の両端部（溶接部）の組成がそれぞれの鋼材（例えば、フェライト系鋼とオーステナイト系鋼）の組成に近似しているので、それぞれの鋼材と中間材との溶接方法は従来と同様（例えばアーク溶接，TIG 溶接等）でよく、例えばフェライト系，オーステナイト系の溶接材料を用いて、工事現場等で直接溶接することができる。また、それぞれの溶接部は、熱膨張係数が同一又は近似しているので、溶接部に熱応力がほとんど発生せず、かつ高温環境下での使用しても熱膨張差により熱応力がほとんど発生しないので、損傷のおそれがない。更に、中間材（1 3）の成分が段階的に変化しているので、中間材内部に発生する熱応力も非常に低くなる。更に、中間材を HIP 等の粉末冶金法により製造し、最終溶接は、例えばアーク溶接，TIG 溶接等で直接溶接するので、円筒形部材（例えば管材）に限定されず、平板等の鋼材にもそのまま適用することができる。

**【0009】**

**【発明の実施の形態】** 以下、本発明の好ましい実施形態を図面を参照して説明する。図 1 は、本発明による溶接方法の模式図であり、図 2 は、中間材の模式図である。以下、組成の異なる 2 種の鋼材 1 1，1 2 として、フェライト系鋼管とオーステナイト系鋼管とを溶接する場合について説明する。なお、本発明は、かかるフェライト系とオーステナイト系の溶接に限定されず、組成の異なる 2 種の鋼材に広く適用することができる。また、この実施形態では、管同士の溶接を説明するが、本発明は管の溶接に限定されず、例えば板同士の接合、その他にも同様に適用することができる。

**【0010】** 本発明の溶接方法を実施するために、予め中間材 1 3 を製造する。この中間材 1 3 は、2 種の鋼材

11, 12 (フェライト系鋼管とオーステナイト系鋼管)と溶接する部分(以下、単に両端部という)の組成がそれぞれの鋼材の組成に近似するように、成分を段階的に変化させて粉末冶金法により製造する。

【0011】例えば、同一径の管同士を接合する場合には、中間材13を円筒形の短管形状とし、その一端部をフェライト系鋼管と同一の組成(Cr含有量が非常に低い)とし、他端部をオーステナイト系鋼管と同一の組成(Cr含有量が高い)とし、その中間部分をフェライト系とオーステナイト系の中間組成にする。この組成の変化は、好ましくは図2に例示するように傾斜勾配に連続的に変化させるのが良いが、少なくとも3段階以上にステップ状に変化させてもよい。なお、この中間材13は、HIP等の粉末冶金法により容易に製造することができる。

【0012】次に、フェライト系鋼管11とオーステナイト系鋼管12の間に、製造した中間材13(短管)を介在させ、中間材13と2種の鋼材11, 12とをそれぞれ溶接する。この場合、中間材13の両端部を、フェライト系端部をフェライト系鋼管11に、オーステナイト系端部をオーステナイト系鋼管12に溶接することは勿論である。この溶接は、同種鋼管の溶接となるので、溶接方法は従来と同様(例えばアーク溶接, TIG溶接等)でよく、例えばフェライト系, オーステナイト系の溶接材料を用いて、工事現場等で直接溶接することができる。

【0013】なお、本発明は上述した実施形態に限定されず、本発明の要旨を逸脱しない範囲で種々変更できることは勿論である。

【0014】

【発明の効果】上述したように、本発明の溶接方法によれば、中間材(13)の両端部(溶接部)の組成がそれ

ぞれの鋼材(例えば、フェライト系鋼とオーステナイト系鋼)の組成に近似しているので、それぞれの鋼材と中間材との溶接方法は従来と同様(例えばアーク溶接, TIG溶接等)でよく、例えばフェライト系, オーステナイト系の溶接材料を用いて、工事現場等で直接溶接することができる。また、それぞれの溶接部は、熱膨張係数が同一又は近似しているので、溶接部に熱応力がほとんど発生せず、かつ高温環境下での使用しても熱膨張差により熱応力がほとんど発生しないので、損傷のおそれがない。更に、中間材(13)の成分が段階的に変化しているので、中間材内部に発生する熱応力も非常に低くなる。更に、中間材をHIP等の粉末冶金法により製造し、最終溶接は、例えばアーク溶接, TIG溶接等で直接溶接するので、円筒形部材(例えば管材)に限定されず、平板等の鋼材にもそのまま適用することができる。

【0015】従って、本発明の組成の異なる鋼材の溶接方法は、組成の大きく異なる鋼材、例えば、フェライト系鋼材とオーステナイト系鋼材を、特殊設備を用いることなく、工事現場等で直接溶接することができ、かつ管材以外の鋼材にも適用できる、等の優れた効果を有する。

【図面の簡単な説明】

【図1】本発明による溶接方法の模式図である。

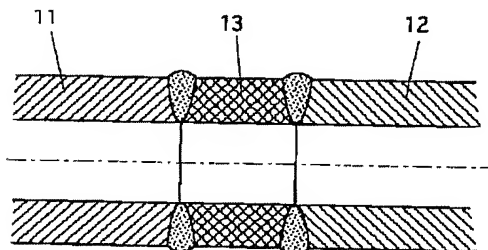
【図2】中間材の模式図である。

【図3】従来の異材溶接方法の説明図である。

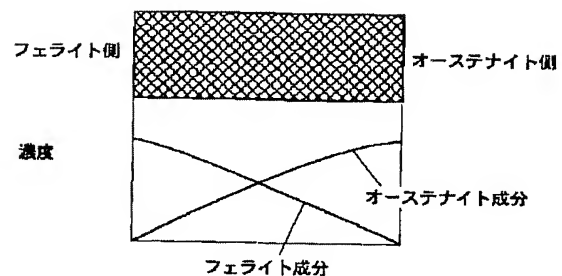
【符号の説明】

- 1, 2, 3 管体
- 4 接合面(摩擦溶接面)
- 7, 8 管体接続部
- 11, 12 鋼材
- 13 中間材

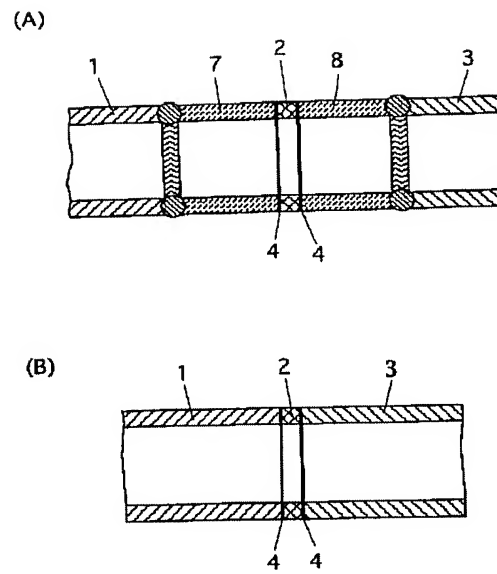
【図1】



【図2】



【図 3】



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